

## REMARKS

By the present Amendment, claim 25 is amended to correct a typographical error in line 1 thereof. This leaves claims 15-35 pending in the application, with claims 15 and 25 being independent.

Since claims 15-24 and 35 are allowed, the record will not be burdened with further comments thereon.

### Rejections Under 35 U.S.C. § 103

Claim 25 covers a device for igniting combustion of fuel in a combustion space 5 of an engine 2. The device comprises a microwave source 7 located outside of the combustion space and producing spaced microwave pulses. A microwave window 13 is connected to the microwave source through which the microwave pulses are injected in and uniformly throughout the combustion space of the engine to be absorbed by the fuel uniformly in all of the combustion space with the temperature of the fuel being increased uniformly by the microwave pulses when absorbed by the fuel due to the energy delivery, without forming plasma by selection of a time interval for injecting the microwave pulses, of power of the microwave pulses, of pulse duration and of pulse spacing, up to an ignition temperature.

The device, as claimed, relates to increasing the temperature fuel in the combustion space of an engine by a microwave source injecting microwave radiation in spaced microwave pulses over a large volume in the combustion space. The microwave radiation is in the form of one or more spaced pulses of short duration and high energy. The formation of a plasma is prevented in the combustion space by the choice of the time interval of injection of microwave energy, its power, its pulse duration and its pulse space up to an ignition temperature.

None of the cited patents discloses or renders obvious this process or device.

Claims 25-30 apparently stand rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 4,138,980 (not 4,138,890 as stated in the Office Action) to Ward. The Ward '980 patent is cited for a microwave source 10 located outside the combustion space 22 and producing space microwave pulses, and a microwave window (provided by spark plug 20) connected to the microwave source. The injection of microwave pulses uniformly throughout the combustion space and absorbed by the fuel with the temperature being increased uniformly without the formation of a plasma is alleged to be obvious in view of the disclosure in the Ward '980 patent at col. 3, lines 37-45, based on the allegation that it would be obvious to modify the Ward '980 microwaves for uniform distribution and maintaining an equilibrium. Additionally, it is contended that these features relate to the use of the apparatus and not the structure of the apparatus, and thus, cannot serve to patentably distinguish the claims based on M.P.E.P. §2114 (copy enclosed). Relative to claim 26, the Ward '980 microwave window 20 is alleged to be mounted on the engine at its combustion chamber. Relative to claim 27, the Ward '980 microwave source is allegedly connected to an electric power supply to deliver electrical pulses to the microwave source converted to microwave pulses. Relative to claim 28, the Ward '980 patent is cited as disclosing the coupling of the microwave source and the microwave window to transmit the pulses and avoid transmitting microwaves reflected by the combustion space back into the source. Relative to claim 29, the Ward '980 patent is cited as disclosing a coupler 24a connected to microwave source 10a and microwave window 22. Relative to claim 30, the Ward '980 patent is alleged to disclose the coupler having first, second and third ports connected to the microwave source, microwave window and passive microwave consumer 16, 24a-28a.

Claims 31 and 32 stand rejected under 35 U.S.C. §103 as being unpatentable over the Ward '980 patent in view of U.S. Patent No. 4,297,983 to Ward. The Ward '983 patent is cited for a microwave window comprising ceramic material which allegedly would be obvious to provide in the Ward '980 patent.

Claim 33 stands rejected under 35 U.S.C. §103 as being unpatentable over the two Ward patents when further considered in view of U.S. Patent No. 2,563,952 to Nichol. The Nichol patent is cited for a flexible microwave line 19 which is alleged to be obvious to use in the combination of the two Ward patents.

Claim 34 stands rejected under 35 U.S.C. §103 as being unpatentable over the two Ward patents and the Nichol patent when further considered in view of U.S. Patent No. 3,934,566 to Ward. The Ward '566 patent is cited for a diesel engine which allegedly would be obvious to use in the combination of the other two Ward patents and the Nichol patent.

Claim 25 recites a microwave source producing spaced microwave pulses. Although the cited patent of the Ward '980 patent discloses varying frequencies with the corresponding wavelengths, such variation produces standing waves or cavity modes to maintain high electrical fields. That disclosure does not constitute a microwave pulse or spaced microwave pulses. Cycles of microwave radiation do not constitute pulses that have a definite beginning and end and have a spacing. The Ward '980 patent involves a continuous supply of radiation to provide the standing waves. In this manner, claim 25 is distinguishable by a microwave source that produces spaced microwave pulses, providing a structural difference between the claimed invention and the Ward '980 patent.

The Ward '980 patent, cited and applied against the claims of this application, involves a technique for increasing the efficiency of an internal combustion engine by exciting a resonant mode of the engine's combustion chamber. The exciting of the resonant mode in the Ward '980 patent produces standing waves within the combustion chamber (col. 3, line 42; col. 4, line 8). This resonant mode is continuously excited (col. 2, lines 34-36) and uses a continuous wave magnetron (col. 4, lines 51-52). The power level of the radio frequency energy is on the order of 100 watts, i.e., between 10 watts and 1,000 watts (col. 5, line 34-35), particularly 600 watts (col. 7, line 59). In the Ward '980 system, the radio frequency energy is coupled to a combustion plasma air-fuel mixture, preferable at a plasma frequency (col. 2, lines 32-34).

Contrary to the system disclosed in that Ward '980 patent, the present invention involves a device in which the microwave source produces microwave energy in the form of spaced pulses of short duration and time, and not continuously as in the Ward '980 patent. In this manner, the claimed device is patentably distinguishable over the Ward '980 patent by the source of microwave pulse or pulses. Relative to microwave pulses, col. 3, lines 37-45, the Ward '980 patent is particularly cited. Although this portion of the Ward '980 patent discloses varying frequencies with corresponding wavelengths, such are done to produce standing waves or cavity modes to maintain continuous high electric fields. Such disclosure does not constitute a source of spaced microwave pulses of short time duration and high energy, or teach modifying the Ward '980 patent radiation to provide a device producing spaced microwave pulses, as alleged. Cycles of the microwave radiation do not constitute or teach pulses that have a definitive beginning and end, and a spacing, in contrast to the Ward '980 patent continuous supply of radiation to providing standing waves.

Additionally, the Ward '980 system involves the formation of a plasma. In contrast, the present claimed invention prevents formation of the plasma. The Ward '980 patent control of frequency/oscillation does not correspond to the control of pulse duration and spacing, as recited in the claims. The Ward '980 plasma formation further patentably distinguishes the claimed device with its microwave source over the Ward '980 patent.

Further, the present claimed invention includes the microwave source with microwave pulses to increase the temperature of the fuel. In contrast, the Ward '980 patent only uses radio frequency energy to enhance precombustion conditioning, with the ignition being initiated by spark plugs 20. Thus, the claims are further patentably distinguishable over the Ward '980 patent by the microwave source increasing of the fuel temperature up to an ignition temperature by microwave pulses.

The claim language relied upon for patentability describes the characteristics of the microwave source. Thus, that language relates to structural features that should be given proper patentable weight.

Accordingly, claim 25 is patentably distinguishable over the Ward '980 patent. None of the other cited patents cure these deficiencies in the cited and applied Ward '980 patent.

Claims 26-34, being dependent upon claim 25, are also allowable for the above reasons. Moreover, these dependent claims recite additional features further distinguishing them over the cited patents.

Claim 26 is further distinguished by the microwave window being mounted on the engine at its combustion chamber. No such microwave window is disclosed or rendered obvious by the Ward '980 patent. The Ward '980 spark plug 20 is not shown to constitute the claimed window.

Claim 27 is further distinguished by the claimed electric power supply source delivering electrical signals to the microwave source converted to spaced microwave pulses by the microwave source. No such structure for generating spaced microwave pulses is disclosed or rendered obvious by the Ward '980 patent.

Claim 28 is further distinguished by the coupling allowing microwave transmission into the chamber but avoiding transmission of microwaves reflected from the combustion space back into the microwave source. Ward '980 cylinder 22 does not constitute such a window.

Claim 29 is further distinguished by the coupler being connected to the microwave source and the microwave window. Ward '980 high voltage DC block is not shown to be the claimed coupler.

Claim 30 is further distinguished by the three ports being connected to the microwave source, microwave window and passive microwave consumer, respectively. No such connection is disclosed or rendered obvious by cylinder 22, distributor 16, blocks 24a-d and power high frequency filters 28a-d of the Ward '980 patent.

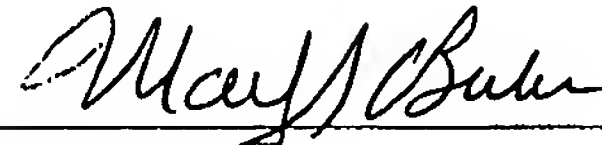
Claims 31 and 32 are further distinguishable by the microwave window being ceramic material (claim 31) or formed completely of ceramic material (claim 32) within the overall claimed combination.

Claim 33 is further distinguished by the flexible line, within the overall claimed combination.

Claim 34 is further distinguished by the particular engines recited therein, within the overall claimed combination.

In view of the foregoing, claims 15-35 are allowable. Prompt and favorable action is solicited.

Respectfully submitted,



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